Meeting Summary: June 2, 2011 N_2O Stakeholder's Meeting

Research Updates

ARB Contracts, Will Horwath (UC Davis)

Assessment of Baseline Nitrous Oxide Emissions in California Cropping Systems (ARB funded): N2O Fluxes in Lettuce, Tomatoes, Wheat, Alfalfa and Rice

The study examines N2O fluxes for different fertilizer rates over two full years for each crop. The data will also be used to evaluate best management practices (BMPs) and to calibrate and validate the De-Nitrification and Decomposition Model (DNDC) for California crops and conditions. Control plots are located on the UC Davis campus and fertilizer rate trials are conducted at agricultural research stations and/or grower fields. Lettuce trials were completed in 2010, tomato and wheat trials will be completed in 2011. Alfalfa trials will be completed in 2012; N2O fluxes will be monitored with no N fertilizer inputs. Results so far show N2O fluxes increase exponentially with linear increases in N application rates. Baseline N2O emissions contribute 20-30% and precipitation, cultural and fertilizer events comprise 70-80% of N2O emissions. While additional analyses are pending, initial results indicate N2O fluxes of 0.3 – 0.6% of N inputs. This rate did not reflect the new emission data collected in early spring of 2011, and so may be an underestimate. No emissions have been observed from alfalfa. No new data were presented for the rice trials.

NOx "Add On" Study to Improve Ozone Modeling In an effort to improve the predictive capability of ozone modeling, this study evaluates NOx flux concurrently with N2O flux in the ongoing baseline crop (above) and dairy system (below) studies. Initial results indicate that NOx is predictable and can be modeled, but N2O is not predictable, except by event (precipitation, fertilizer input, tilling). Monitoring for 2011 began in April.

Assessment of Baseline N2O in Dairy Systems. This one-year study will develop N2O emission estimates and emission factors by evaluating 5 events in silage corn receiving dairy lagoon water, corral manure and inorganic nitrogen as fertilizer. It will evaluate zero N inputs, reduced tilling and conventional tilling as variables. Monitoring began recently following the planting of summer forage crops. Initial results indicate significant NOx emissions.

CalRecycle Contract, Will Horwath, (UC Davis)

This study will evaluate N_2O and CH_4 emissions from the compost life cycle, including emissions from finished compost additions to almonds, tomatoes and row crops. The study was begun in tomatoes in 2010 and continues in 2011. Measurements have been collected since the fall of 2010. Sites include grower fields in Esparto and plots on the UC Davis campus.

An agreement has been finalized to monitor emissions from compost additions to almond orchards at the Nickels Ranch. Lab incubations are ongoing to evaluate N2O emissions following the addition of compost to different soil types.

At the Zamora composting facility, three emissions monitoring approaches will be investigated in composted greenwaste with mechanically turned windrows: gradient (static chamber), flux chamber (dynamic) and eddy current (micro met). Gradient and flux chamber monitoring are underway, the eddy current monitoring will commence pending consultation with experts in the technolology. Thus far, the gradient approach has not been successful because the CH4 levels are so high that they overwhelm the static chambers and emissions are significantly underestimated.

It appears that CH4 in compost is not a methanogenic process, but a demethylation of pectin. Later in the study, monitoring will be conducted in composted greenwaste mixed with up to 15% food wastes, and reverse aerated (induction through the piles).

CEC Contracts: Johan Six (UC Davis)

N2O Emissions from the Application of Fertilizers in Agricultural Soils

There are no new data for this update. Monitoring continues for all crops, with almonds nearing completion of the second year of monitoring, and walnuts, tomatoes and vineyards beginning the second year of monitoring. The observed emission factor for almonds was not available but was characterized as "low". Overall, vineyards show a lower emission factor (about 0.3% of N inputs) compared to the other crops, but vineyards also had few fertilizer inputs. Vineyard emissions are associated with mowing the leguminous cover crop in the tractor rows and with the vine row receiving surface drip irrigation, which is a low emission practice. The observed emission factor for conventional tomatoes (conventional tillage, furrow irrigation, fertilizer shanked into bed sides, rip/reform beds) is close to 1% of N inputs. For the integrated system (reduced tilling, sub-surface drip irrigation and fertigation, winter grain cover crop, preserve planting beds), it is about 0.3% of N inputs. The integrated system is also being evaluated as part the David and Lucille Packard Foundation grant (see http://news.ucdavis.edu/search/news_detail.lasso?id=9136), whose focus is on developing baseline estimates for agricultural management practices. The grower has used the integrated system for 8 years. So far, the integrated system has reduced N2O emissions by 250% and provided slightly higher yields, using the same or slightly less fertilizer.

The potential of biochar soil amendments as a carbon sequestration method in California agriculture

A three-year research project began this spring in a walnut orchard and at a vineyard. No updates were available for the vineyard study. At the walnut growing/drying/packing operation, the biochar feedstock is walnut shells, pyrolyzed under anaerobic conditions at 900 ºC. The process generates electricity for on-site use and produces 1% by weight of carbon stock as biochar. Thus far, better cover crop growth was noted for the biochar plot. However, this effect may be due to surface tilling the soil, because similar growth was observed for the control plots, which were also tilled. Previously, these portions of the walnut orchard had not been tilled for 20 years. Soil moisture is also being tracked: biochar seems to slightly increase the water holding capacity, which is not surprising, since biochar increases cation exchange capacity. It is not yet known how biochar may affect N2O emissions.

A greenhouse experiment on the UC Davis campus is also underway, using lettuce as a test crop. It uses bioassays to evaluate the N2O emissions from applying different types of biochar. So far, significant emissions have been observed for a commercial biochar, which contains an inoculum.

ARB Contract: Dr. Changsheng Li (Univ. New Hampshire)

Calibrating, validating, and implementing process models for CA agriculture greenhouse gas emission estimation

On behalf of Dr. Li, Dr. William Salas, of Applied Geosolutions, LLC, provided a project overview, available at http://arb.ca.gov/ag/fertilizer/110602_DNDC.pdf . The project focuses on validating and calibrating the De-nitrification and Decomposition Biogeochemistry Model

(DNDC) for California crops, soils, and agricultural management practices. DNDC is a computer simulation model of carbon and nitrogen biogeochemistry in agro-ecosystems, with microbial activity in soil redux dynamics as the main driver. The project will provide data to reduce the DNDC's scaling and structural uncertainties for California crops and conditions in both aerobic and anaerobic (flooded rice) systems. Twenty cropping systems, representing California's dominant acreage for both annual and perennial crops, will be evaluated over a two-year period. ARB staff also conducted a brief contract kick-off with project collaborators, Johan Six, Will Horwath and William Salas.

CDFA Contract: Dave Goorahoo (CSU Fresno)

Measuring and Modeling Nitrous Oxide Emissions from California Cotton, Corn, and Vegetable Cropping Systems

Dr. Goorahoo had no new updates, but provided a summary of this year's activities, available at: http://arb.ca.gov/ag/fertilizer/110602_CDFA.pdf . He reported he made arrangements with the city of Fresno to use their Agilent GC and that the field sites and instruments are ready for this year's monitoring campaign.

Next Steps: The next N_2O Stakeholders meeting is planned for Monday, September 12, 2011, in Modesto. The project PIs and ARB staff will travel to Modesto. Other attendees are invited to attend in person or by phone. Details regarding meeting location, time, call-in information, and meeting agenda will be provided when determined.